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Notes on taxonomy and distribution of the *Stichophthalma howqua* (Westwood, 1851)-group

(Lepidoptera, Nymphalidae)

by

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Abstract: In this paper, a checklist of the *Stichophthalma howqua* (Westwood, 1851)-group is given, and *S. howqua xizhengensis* Zhao, 1997 **syn. nov.** is found to be a new junior synonym of *S. suffusa suffusa* Leech, 1892. The distributional pattern of the *howqua*-group is studied basing upon examined materials, literatures and other available informations. For the above-mentioned distributional pattern, a hypothesis of its cause of formation is given, it is the invasion of *S. suffusa* Leech during the Holocene Epoch.

The *Stichophthalma howqua* (Westwood, 1851)-group (Morphinae: Amathusiini) includes two species, they are *S. howqua* (Westw.) and *S. suffusa* Leech, 1892. Before Monastyrskii & Devyatkin (2008), all taxa of the *howqua*-group had been considered as a single species, namely *S. howqua* (Westw.). The two species can be easily distinguished from each other by the following external character: Dorsal hindwing with black arrow markings are distinct in *S. howqua* (Westw.) (fig. 1a), whereas in *S. suffusa* Leech those black arrow markings are confluent (fig. 1b).

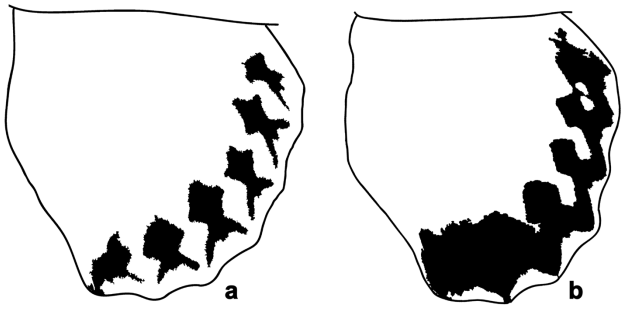

Fig. 1: Dorsal hindwing of the *howqua*-group. a = ♂ *Stichophthalma howqua* (Westwood, 1851) from Zhejiang. b = ♂ *S. suffusa* Leech, 1892 from Sichuan.

Materials and Methods: On the distribution map of the *howqua*-group in this paper (fig. 2b), those distributional sites in China were mainly acquired from the labels of examined materials (see Appendix). Some Chinese localities, where no specimen has been examined in this research, are also plotted on the map basing upon the following resources: 1. Mrs. Blanca Huertas provided photographs of the type of *Thaumantis howqua* Westwood, 1851 from Shanghai which is deposited in the Natural History Museum, London, UK (NHML, former BMNH); 2. Mr. Lo Philip Yikfui from Hongkong showed the author a picture of a ♂ *S. suffusa* Leech which was collected from Mt. Babaoshan, Yingde, N. Guangdong and is deposited in the collection of Kadoorie Farm and Botanic Garden, Hongkong; 3. Mr. Li Yufei who collected butterflies in S. Shaanxi for decades kindly told the author several sites in S. Shaanxi (Taibai, Liuba, Nanzheng and Ningshan) where specimens of *S. suffusa* Leech had been caught by him; 4. Mr. Liu Zihao from Anhui Province showed the author pictures of a ♂ *S. howqua* (Westw.) which was caught by him from Mt. Huang in S. Anhui this summer; 5. The distributional site Chengkou in Daba Shan Mts. of N. Chongqing is acquired from the paper Liu & Deng (2001). Those sites of N. Vietnam (Sa Pa, Lang Son: Than Moi, Ha Nam Ninh: Cuc Phuong, Vinh Phu: Tam Dao and Thai Nguyen) on the distribution map are acquired from the following literatures and website: Brooks (1949), d'Abrera (1985), Spitzer & Jaroš (1996), Nishimura (1998), Monastyrskii & Devyatkin (2008), and Inayoshi (http://yutaka.it-n.jp/). Some localities are adjacent with each other, then the author combines them to one site on the distribution map. Examined materials in this study are deposited in the following collections: the Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZCAS), Chongqing Museum of Natural History, Beibei, Chongqing, China (CMNH) and Dr. Lang Songyun's Private Collection, Chengdu, Sichuan, China (LSY).

Checklist of the *Stichophthalma howqua* (Westwood, 1851)-group

S. howqua howqua (Westwood, 1851), TL: Shanghai.
S. howqua formosana Fruhstorfer, 1908, TL: Formosa [Taiwan].
S. howqua bowringi Joicey & Talbot, 1921, TL: Five Finger Mts. [Mt. Wuzhishan], Hainan.
S. howqua iapetus Brooks, 1949, TL: Cochin China, Chapa [Sa Pa, N. Vietnam].
S. suffusa suffusa Leech, 1892, TL: Omei-shan, Sichuan (= *S. howqua xizhengensis* Zhao, 1997 **syn. nov.**, in Chao [Zhao] & Wang: 286. TL: Lizi [Linzhi], Xizhang).
S. suffusa miyana Fruhstorfer, 1913, TL: Canton [N. Guangdong].
S. suffusa tonkiniana Fruhstorfer, 1901, TL: Than-moi, Tonkin [N. Vietnam].

Taxonomic notes: *S. howqua iapetus* Brooks, 1949 was mistakenly considered as a subspecies of S. Vietnam (Cochin China) for a long time, because its original paper (Brooks, 1949) states "*Stichophthalma howqua iapetus* subsp. nov. …… Cochin China, Chapa, September, 1936, 4 ♂♂, 4 ♀♀, including the types (S. Masseyeff)". According to Monastyrskii & Devyatkin (2008), the taxon i*apetus* Brooks was described from Chapa (=Sa Pa) which is a place in Lao Cai province in N. Vietnam but not in Cochin China or S. Vietnam.
S. howqua xizhengensis Zhao, 1997 was described from Linzhi, SE. Tibet basing upon a single ♀. This taxon has been overlooked

for years since its publication. Its type locality is also doubtful. The southern part of Linzhi district (the Namjagbarwa Region) belongs to eastern section of the Great Himalayas. There are very nice subtropical latifoliate forests at suitable altitude, which serve as habitats for *S. camadeva aborica* Tytler, 1939 and *S. neumogeni renqingduojiei* Huang, 1998. Except Zhao (1997), no other record of the *howqua*-group has been reported from this region, though several important entomological expeditions covered this area, for example, expeditions of IZCAS (1973, 1974, 1982-1983, 2006), the famous exploration of Capt. F. M. Bailey (1913), and voyages of Mr. H. Huang (1995, 1996, 2005). So in my opinion, it is impossible that one taxon of the *howqua*-group is obtained from SE. Tibet, and the type locality of *S. howqua xizhengensis* Zhao must be a wrong record. The holotype ♀ of *S. howqua xizhengensis* Zhao **syn. nov.**, figured in the original description, can not be separated from the ♀ of *S. suffusa suffusa* Leech from W. China soundly, therefore the author treats this taxon as a junior synonym of *S. suffusa suffusa* Leech.

Distribution of the *Stichophthalma howqua* (Westwood, 1851)**-group**: The *howqua*-group, whose larva feeds on leaves of diversiform bamboos, inhabits montane tropical and subtropical rainforests in S. China and N. Vietnam (fig. 2a). Adults of this group as well as other butterflies of the genus S*tichophthalma* Felder & Felder, 1862 only reside in closed forest and small forest gaps in mountain areas, but seldom fly over wide open land, for instance large croplands or towns. Therefore, butterflies of this genus can hardly migrate to a new site through a long distance flight without the shadow of jungles.
The present colony of *S. suffusa* Leech is expansive and continuous, it is from SW. China (Sichuan, E. Yunnan, Guizhou, S. Shaanxi and W. Hubei) eastwards to NE. Fujian in SE. China through the corridor of Nan Ling Mts.-Wuyi Shan Mts., and is from S. Shaanxi (Qin Ling Mts.) southwards to SE. Yunnan and N. Vietnam. However, the existent range of *S. howqua* (Westw.) is separated by the colony of *S. suffusa* Leech and sea straits to several isolated small habitats, including E. China (Shanghai, S. Anhui and Zhejiang), N. Jiangxi, NE. Hunan, Hainan Island, Taiwan Island and NW. Vietnam. Generally *S. howqua* (Westw.) and *S. suffusa* Leech are allopatric, but *S. howqua iapetus* Brooks and *S. suffusa tonkiniana* Fruhst. are sympatric at Sa Pa in NW. Vietnam (Monastyrskii & Devyatkin, 2008) and probably also at SE. Yunnan (near NW. Vietnam).
The Hengduan Shan Mts. region containing W. Sichuan, E. Tibet and NW. Yunnan belongs to the Tibetan Plateau. This region is composed of series of north-south orientated snow mountains from east to west. Excluding its moist east in C. Sichuan (including the east slope of Qionglai Mts., lower Daduhe or Tung Ho Valley and Minjiang River basin) and humid southwest in NW. Yunnan (the Nujiang or Salween Valley), a majority of the Hengduan Shan Mts. belongs to the Palaearctic region where no species of the jungle genus S*tichophthalma* Felder & Felder has been recorded. In the Nujiang Valley of NW. Yunnan, the *howqua*-group is replaced by *S. sparta gongshana* Huang, 2003.
In the Indo-China Peninsula, the *howqua*-group is replaced by the *S. louisa* (Wood-Mason, 1877)-group. According to Monastyrskii & Devyatkin (2008), The latter includes the following taxa: *S. louisa* (Wood-Mason, 1877), *S. louisa antonia* Röber, 1926, *S. louisa ranohngensis* Okano, 1985, *S. louisa siamensis* Rothschild, 1916, *S. mathilda* Janet, 1905 and *S. eamesi* Monastyrskii, Devyatkin & Uémura, 2000.

Hypothesis: The invasion of *Stichophthalma suffusa* Leech, 1892 **during the Holocene**: Comparing with the expansive and continuous colony of *S. suffusa* Leech, the colony of *S. howqua* (Westw.) is fragmental and separeated to several small patchs. Excepting some biological factors, interspecific competition for instance, the nowadays distributional pattern of the *howqua*-group apparently has close relationships with the geological events in E. Asia from the Late Pleistocene to the present day.
During the last Pleistocene glaciation, *S. howqua* (Westw.) probably had a large and continuous colony containing S. China (including Taiwan and Hainan) and NE. Indo-China Peninsula. In that period, Taiwan and Hainan connected with Asian mainland because of lower sea level. During the same period, the colony of *S. suffusa* Leech was probably only confined in several warm valleys of eastern part of the Hengduan Shan Mts. in C. Sichuan, which acted as the last refuges for many subtropical relict animals and plants. More likely, the colonies of both *S. suffusa* Leech and *S. howqua* (Westw.) were separated from each other during the last ice age for some unknown reasons, and the geographical isolation might lead that *S. suffusa* Leech evolved from a local geographical race of *S. howqua* (Westw.) to a distinct species. The above-mentioned historical distributional pattern of the *howqua*-group probably had been maintained until the beginning of the Holocene Epoch.
At the beginning of the Holocene Epoch, the northern border of the subtropical zone began its moving northwards to higher latitude on the Northern Hemisphere. From then on, *S. suffusa* Leech as well as *S. howqua* (Westw.) began to enlarge its own colony to new habitats. Synchronously, the habitats of *S. suffusa* Leech in valleys with warm climates in C. Sichuan was connected with the large colony of *S. howqua* (Westw.) again. It was unavoidable that *S. suffusa* Leech and *S. howqua* (Westw.) expanded their own colonies to each other. Therefore, it was inevitable that an intense competition happened between the two species which are sibling species with same or similar niches. Obviously, the present distributional pattern tells people that: *S. suffusa* Leech predominated the competition, and its invasion of the colony of *S. howqua* (Westw.) began.
The westward expansion of *S. suffusa* Leech has been blocked by those great snow mountains of Hengduan Shan. But in S. & E. China, the route of the eastward expansion of *S. suffusa* Leech was along the mountainous ridges of Nan Ling Mts.-Wuyi Shan Mts., which are the highest in this region. The ridges acted as a corridor for the *S. suffusa* Leech's invasion eastward. Through the mountainous corridor, the colony of *S. suffusa* Leech penetrated into the heart area of the old empire of *S. howqua* (Westw.). The insular populations of *S. howqua* (Westw.) in Taiwan and Hainan have been survived successfully because of island isolation from mainland. Those small survival populations of *S. howqua* (Westw.) in Zhejiang, S. Anhui, N. Jiangxi and NE. Hunan are probably undergoing a high pressure from the *S. suffusa* Leech's invasion. Or species replacements between the two have been stopped provisionally in the above-mentioned areas, because of the fragmentation of suitable habitat which was caused by the development of agriculture and civilization. The fragmentation of the residual habitats of *S. howqua* (Westw.) not only can block its own intraspecific communion, but also can block the *S. suffusa* Leech invasion of its isolated refuges. At the NE. Indo-China Peninsula, the *S. suffusa* Leech invasion caused that the Vietnamese subspecies *S. howqua iapetus* Brooks has retreated to a small area which is far away from habitats of other subspecies of *S. howqua* (Westw.). Monastyrskii & Devyatkin (2008) reported the sympatric distribution of *S. howqua iapetus* Brooks and *S. suffusa tonkiniana* Fruhst from NW. Vietnam. The coexistence of the two species in NW. Vietnam maybe reveals that the two species have a provisional balance for some unknown reasons, or *S. howqua iapetus* Brooks is disappearing.

The End: At the end, people can notice that there is no tendency of blend between the two species, *S. howqua* (Westw.) and *S. suffusa* Leech. Instead, there is a severe competition between the two kinds. Taking into account this factor, the author can safely follow

the viewpoint of Monastyrskii & Devyatkin (2008) that: *S. suffusa* Leech is a bona species, but is not a geographic subspecies of *S. howqua* (Westw.). To soundly prove the author's hypothesis, namely the *S. suffusa* Leech's invasion, future researches basing upon more collecion trips, study on immature stages of different populations, biogeographic methods and molecular biological techniques are urgently needed.

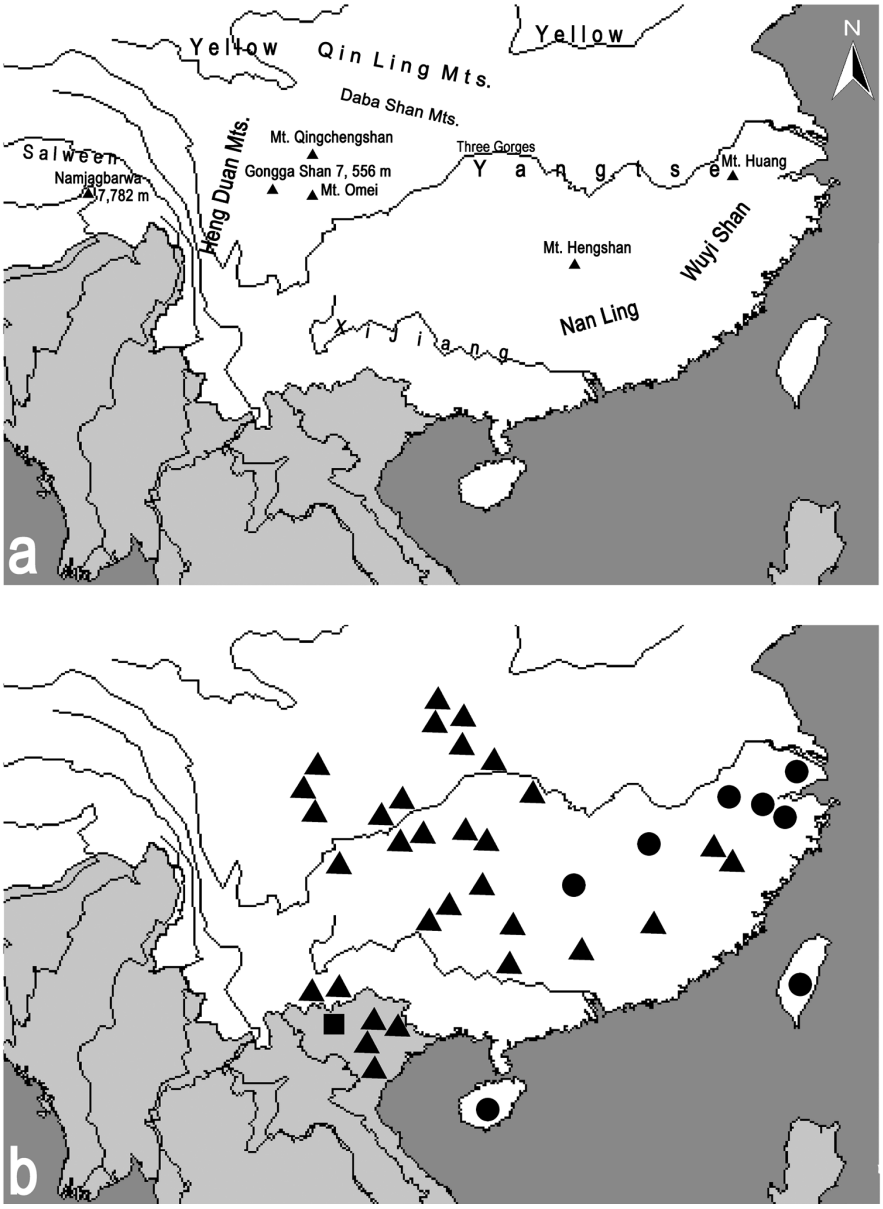

Fig. 2: Map. a = Map of South China and northern Indo-China Peninsula. b = Distribution map of the *howqua*-group: - black round = *Stichophthalma howqua* (Westwood, 1851); black triangular = *S. suffusa* Leech, 1892; black square = sympatric site of S. *suffusa tonkiniana* Fruhstorfer, 1913 and *S. howqua iapetus* Brooks, 1949.

Appendix: material examined

Stichophthalma howqua (Westwood, 1851)

4 ♂♂, 1 ♀, Zhejiang: Mt. Tianmushan, 5.-21.VII.1936, 26.VIII-2.IX.1947, colls. O. Piel et al. (IZCAS); 2 ♂♂, Zhejiang: Mt. Tianmushan, 27.VI-1.VII.1957, coll. Su Jiyao (IZCAS); 3 ♂♂, 2 ♀♀, Zhejiang: Lin'an, Mt. West Tianmushan, 400-1500 m, 28.-30.VII.2003, colls. Xue Dayong et al. (IZCAS); 1 ♂, Zhejiang: Mt. Moganshan, 8.IX.1936 (IZCAS); 1♂, Zhejiang: Anji, VI.1978 (IZCAS); 1 ♀, Zhejiang: Zhuji, VII.1981 (IZCAS); 1 ♂, Zhejiang, VII.1986 (IZCAS); 11 ♂♂, Jiangxi: Yifeng, Yuanqian, 17.-25.VI.1959 (IZCAS); 1 ♂, Hunan: Mt. Hengshan, 1980 (IZCAS); 1 ♂, Taiwan: Mu Sha, 15.VI.1938 (IZCAS); 1 ♀, Taiwan: Tai Hei San, 19.VI.1938 (IZCAS); 1 ♂, 1 ♀, Taiwan (CMNH); 1 ♂, Hainan: Mt. Bawangling, Dong'er Forest farm, 9.V.2007, coll. Chen Fuqiang (IZCAS); 13 ♂♂, 1 ♀, Hainan: Mt. Wuzhishan, Shuiman Village, 730-900 m, 9-11.V.2007, colls. Lang Songyun et al. (IZCAS); 1 ♂, Hainan: Mt. Jianfengling, 18.VII.1983 (IZCAS); 2 ♀♀, Lai-mo-ling [Mt. Limuling], 13.-16.VI.1935, coll. F. K. To (IZCAS).

Stichophthalma suffusa Leech, 1892

1 ♂, Jiangxi: Ganzhou, VI.1979 (IZCAS); 1 ♀, Jiangxi: Guangfeng, 21.VIII.1980 (IZCAS); 1 ♀, Hunan: Yizhang, 3.VII.1981 (IZCAS); 1 ♀, Fujian: Chong'an [Wuyishan], Xingcun, 900 m, 4.VIII.1960, coll. Zuo Yong (IZCAS); 1 ♂, Hubei: Changyang, Mt. Tianzhushan, 1300-1450 m, 14.VII.1998 (CMNH); 1 ♂, Guangxi: Yaoshan, 22.VI.1936 (IZCAS); 1 ♂, Guangxi: Longsheng, Baiyan, 1150 m, 18.VI.1963, coll. Wang Chunguang (IZCAS); 4 ♂♂, Sichuan: Guanxian [Dujiangyan], 700-1000 m, 26.-29.VI.1963, 11.VII.1964, coll. Zhang Xuezhong (IZCAS); 8 ♂♂, 1 ♀, Sichuan: Guanxian [Dujiangyan], Mt. Qingchengshan, 700-1600 m, 25.VI.-17.VIII.1964, 1.VII.1965, colls. Zhang Xuezhong et al. (IZCAS); 1 ♂, Sichuan: Dujiangyan, Mt. Zhaogongshan, VIII.2006, coll. Lang Yi (LSY); 1 ♂, Sichuan: Dujiangyan, 10.IX.1990 (CMNH); 1 ♀, Sichuan: Pengxian [Pengzhou], Bailuding, 20.VIII.1960, coll. Zhang Xuezhong (IZCAS); 1 ♂, 1 ♀, Sichuan: Wenchuan, Yingxiu, 900 m, 3.VIII.1983, colls. Zhang Xuezhong et al. (IZCAS); 2 ♂♂, Sichuan: Wolong, 10.VIII.1986 (CMNH); 5 ♂♂, Sichuan: Mt. Omei, 550-1000 m, 29.VI.-24.VII.1957, colls. Zhang Xuezhong et al. (IZCAS);

3 ♂♂, 1 ♀, Sichuan: Mt. Omei, VII.1995 (CMNH); 1 ♂, Sichuan: Lushan, 1600 m, 15.VII.1984, coll. Liu Dajun (IZCAS); 1 ♂, Sichuan [Chongqing]: Pengshui, Taiyuan, 750 m, 12.VII.1989, coll. Li Hongxing (IZCAS); 1 ♂, Sichuan [Chongqing]: Youyang, Qinghua, 1250 m, 16.VII.1989, coll. Yang Longlong (IZCAS); 1 ♀, Chongqing: Wushan, Luoping, 1050 m, 21.VII.1998 (CMNH); 1 ♀, [Chongqing]: Ginyün [Mt. Jinyunshan], 19.VII.1933 (CMNH); 1 ♂, Sichuan [Chongqing]: Mt. Jinyunshan, 22.VI.1974 (IZCAS); 12 ♂♂, 3 ♀♀, Chongqing: Beibei, Mt. Jinyunshan, 17.-18.VII.2010, coll. Fang Yueming (LSY); 3 ♂♂, Sichuan [Chongqing]: Yongchuan, 1.-25.VII.1981 (IZCAS); 13 ♂♂, 3 ♀♀, [Chongqing]: Ginfu [Mt. Jinfoshan], 800-1200 m, 26.VI.-30.VII.1932 (CMNH); 2 ♀♀, Chongqing: Nanchuan, Huangcaoping, 10.-13.VIII.1990 (CMNH); 2 ♂♂, Chongqing: Jiangjin, Mt. Simianshan, 1100 m, 16.VII.1995 (CMNH); 1 ♂, 1 ♀, Chongqing: Jiangjin, Mt. Simianshan, 930 m, 8.-10.VIII.2010, colls. Li Aimin et Lang Songyun (LSY); 1 ♂, Guizhou: Leishan, Mt. Leigongshan, 1550 m, 30.VI.1988, coll. Wang Shuyong (IZCAS); 1 ♂, Guizhou: Tianzhu, 700 m, 8.VI.1979, coll. Sao Zhen (IZCAS); 1 ♂, 1 ♀, Guizhou: Dushan, VII.2010, coll. Wang Xuejian (LSY); 1 ♀, Yunnan: Yanjin, 700 m, 4.VIII.1980, coll. Yang Fuxing (IZCAS); 1 ♂, Yunnan: Pingbian, 27.VI.1956, coll. Lee Chuanlung (IZCAS); 2 ♂♂, Yunnan: Pingbian, Mt. Daweishan, 1700 m, 29.VI.1956, coll. Lee Chuanlung (IZCAS); 3 ♂♂, Yunnan: Malipo, Bazi, 1300 m, 16.V.1979, coll. Song Wangzhi (IZCAS).

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